

Appl. No. 10/783,495  
Amdt. dated 01/02/2008  
Response to Office Action of 11/05/2007

Attorney Docket No.: N1085-00251  
[TSMC2003-0834]

### **REMARKS/ARGUMENTS**

Claims 1-22 were previously pending in this application. Each of claims 1-22 has been rejected. No claim amendments are filed herein.

5 Applicants respectfully request re-examination, reconsideration and allowance of each of pending claims 1-22. Applicants point out that the subject Office Action dated November 5, 2007 essentially replaces the previously-issued final Office Action dated August 10, 2007, the finality of which has been withdrawn as indicated in paragraph 27, titled *Interview Summary* of the subject Office Action.

10 I. **Claim Rejections in view of Nakayama and Lymberopoulous – 35 U.S.C. § 103**

In paragraph 3 of the subject Office Action, claims 1-4 and 9-11 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,409,538 to Nakayama in view of U.S. Patent Publication No. 2004/0092047 to Lymberopoulous.

15 Applicants respectfully submit that these claim rejections are overcome for reasons set forth below.

Claim 1 represents the independent claim among the claims rejected in this section. Independent claim 1 recites the features of:

20 controlling the exposure energy with a feedback process  
control signal of critical dimension . . . the critical dimension  
being one of a width, a spacing and an opening of the  
patterned wafer substrate.

The primary reference of Nakayama does not teach this feature of using a control signal of critical dimension (CD) for controlling exposure energy. Nakayama, in  
25 contrast, is limited to measuring optical properties of a film such as reflectivity, refractive index, transmittance, polarization, spectral transmittance, and absorption coefficient. As previously pointed out, such optical properties are distinguished from and do not include critical dimensions of features of patterned substrates. Moreover, in order to measure

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optical properties, Nakayama is limited to irradiating an unpatterned substrate and absolutely teaches away from measuring CD's since no features having CD's are present when Nakayama *necessarily* carries out measurements.

Moreover, Applicants point out that the Office Action concedes, on page 3,  
5 second paragraph, that "Nakayama does not expressly teach a patterned wafer substrate, control signal of critical dimension and critical dimension being one of a width, a spacing and an opening of the patterned wafer substrate."

The secondary reference of Lymberopoulous teaches measuring CD's, but Lymberopoulous does not teach the claimed feature of using a CD measurement to  
10 control exposure energy. Lymberopoulous provides no signal to the photo/exposure apparatus or process. In fact, Applicants respectfully submit that Lymberopoulous teaches away from using the CD's to change exposure energy because Lymberopoulous calibrates the CD's and then adjusts subsequent processing operations taking into account the measured CD's. Since Lymberopoulous adjusts  
15 subsequent processing operations such as etch operations, to compensate for the CD's that Lymberopoulous simply accepts as produced, there is certainly no suggestion or need in Lymberopoulous to control exposure energy because, regardless of the CD measurement, Lymberopoulous professes to produce a product of desired quality and dimension by subsequent adjustment/compensation. As known in the art, an etch  
20 recipe can be altered to compensate for CD's that are too high or too low.

Moreover, Applicants respectfully submit that it would not be obvious to combine  
a) the CD's measured on patterned wafers and used to determine subsequent etch recipe parameters, as in Lymberopoulous and b) a method for irradiating a blank, unpatterned substrate for measuring optical properties, to produce the claimed invention  
25 because:

A) Nakayama teaches away from and cannot be used with, a patterned wafer;

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B) Lymberopoulos teaches away from using CD measurements to control exposure energy because the subsequent adjustments made by Lymberopoulos obviate the need to do so; and

5 C) the claimed invention goes a step beyond any proposed combination and is not obvious in view of the references due to the following.

Nakayama measures inherent qualities or characteristics of the film and based on the measured film qualities/characteristics, adjusts the exposure based on the same  
10 (referring to FIG. 18 in which the measurement of the blanket photoresist film is input to the projection aligner). In other words, based on measured film qualities/characteristics, a prediction is made as to an optimal exposure that might be needed to produce optimal pattern quality including correct CD's. In other words, the exposure may be adjusted to an exposure that one thinks might be the desired exposure based on the  
15 qualities/characteristics of the film only and not based on the exposure apparatus or previous results. Applicants again respectfully submit that the goal in optimizing exposure settings, e.g. energy, in an exposure operation is to produce a high quality pattern with a desired and in-spec CD's.

The claimed invention goes a step beyond *predicting* what the exposure  
20 characteristics should be based only on the measured qualities/characteristics of the unpatterned film, and generates a signal based on the actual critical dimensions which are a product of both a) film qualities/characteristics, and b) an exposure operation that was used on that particular film, among other factors. The claimed invention does more than just predict what exposure settings should be used: rather, it uses the actual CD  
25 data produced by an exposure process and feeds back this information to the exposure apparatus. This significant improvement is inventive and not obvious under the conditions of 35 U.S.C. §103. Nakayama predicts how the exposure process should work based on the PR film and the claimed invention takes into account how an exposure process did work for that particular film and can then adjust the exposure  
30 process accordingly. The claimed invention can thus be used to ensure that the next

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CD is as desired. Moreover, Lymberopoulous, as above, teaches away from controlling exposure energy and merely accepts whatever CD's are produced and selects an etch recipe based on the same, i.e., Lymberopoulous provides no signal to the photo/exposure apparatus.

- 5 Applicants respectfully submit that the claimed invention is non-obvious in view of the references because the claimed invention provides the novel feature of controlling exposure energy based on a control signal of an actual CD, and does not simply predict what exposure should be based solely on film characteristics.

10 Claim 1 therefore rises to the level of non-obviousness with respect to Nakayama and Lymberopoulous. Claim 1 is therefore distinguished from Nakayama and Lymberopoulous and therefore the rejection of claim 1, and dependent claims 2-4 and 9-11, under 35 U.S.C. § 103(a) as being unpatentable over Nakayama in view of Lymberopoulous, should be withdrawn.

15 **II. Claim Rejections in view of Nakayama, Lymberopoulous and Saka-**  
**35 U.S.C. § 103**

In paragraph 11 of the subject Office Action, claims 5-8 and 12-22 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Nakayama in view of Lymberopoulous and further in view of U.S. Patent No. 6,798,529 to Saka. Applicants respectfully submit that these claim rejections are overcome for reasons set forth below.

- 20 Claims 5-8 depend from claim 1, which is distinguished from Nakayama in view of Lymberopoulous, as above. The Saka reference has apparently been relied upon for providing features that appear in dependent claims 5-8. Saka, however, directed to end-point detection in chemical mechanical polishing (CMP), does not make up for the above-stated deficiencies of Nakayama and Lymberopoulous. Therefore, claim 1 and  
25 dependent claims 5-8 are distinguished from the references of Nakayama, Lymberopoulous and Saka, taken alone or in combination. The rejection of claims 5-8 under this section should be withdrawn.

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With respect to the rejection of claims 12-22, independent claim 12 recites the features of:

5 a feedback controller providing a feedback exposure energy control signal to the exposure apparatus based on critical dimension measurement of a top layer of a second patterned wafer substrate of a previous manufacturing lot, the critical dimension being one of a width, a spacing and an opening of the second patterned wafer substrate.

10 Independent claim 12 uses a CD control signal fed back to the exposure apparatus and is therefore also distinguished from Nakayama in view of Lymberopoulous for reasons set forth above with respect to claim 1.

15 The Saka reference, directed to chemical mechanical polishing and not CD measurement, does not teach a critical dimension measurement. As discussed in Applicants' previous Response, a critical dimension is a term known in the art and claim 12 was previously amended to even more particularly point out a CD being a width, spacing or opening of a patterned wafer. Nowhere does Saka teach measuring these dimensions. Saka therefore does not make up for the above-stated deficiencies of the combination of Nakayama and Lymberopoulous. Claim 12 is therefore distinguished from the aforementioned references, taken alone or in combination. Claims 13-22 are  
20 similarly distinguished by virtue of their dependencies from claim 12.

Therefore, the rejection of claims 12-22 under 35 U.S.C. § 103(a) as being unpatentable over Nakayama in view of Lymberopoulous and further in view of Saka, should be withdrawn.

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**CONCLUSION**

Based on the foregoing, each of pending claims 1-22 is in allowable form and the application in condition for allowance, which action is respectfully and expeditiously requested.

- 5 The Assistant Commissioner for Patents is hereby authorized to charge any fees necessary to give effect to this filing and to credit any excess payment that may be associated with this communication, to Deposit Account 04-1679.

Respectfully submitted,

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